Macroinvertebrates as indicators of water quality

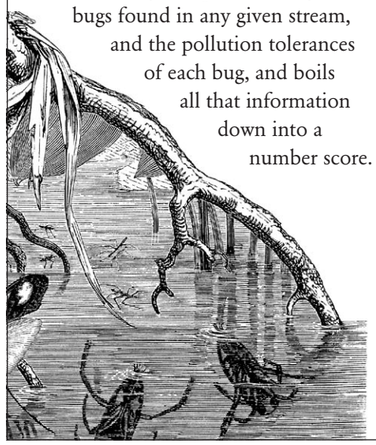
First of all, what's a macroinvertebrate? Invertebrates are animals without backbones. Macroinvertebrates are organisms at least ½ of a millimeter across that are visible to the human eye without a microscope. A few examples include dragonflies and stoneflies. Macroinvertebrates are a particularly useful tool for assessing stream health for several reasons. They are:

- **Ubiquitous:** Where there's water there are bugs, so comparisons can be made from one waterway to the next, and we never have to worry about not finding bugs.
- **Easy to sample:** They're not as hard to catch as fish, and not as difficult to sample as algae or microscopic animals.
- **High biodiversity:** The incredible diversity of invertebrates gives us more different species to use as indicators of changes in water quality. If we sampled five creeks and found the same 25 species in each creek, then we would have a hard time drawing any conclusions. In practice, though, every creek yields a unique bug population and so conclusions can be made easily.
- **Relatively long life span:** The bug population doesn't just give us a snapshot of water quality, but reflects what has been going on in the creek for weeks or months.
- **Restricted in their movements:** Except for the adult forms that fly, macroinvertebrates are restricted to a particular stream reach and so reflect local conditions in the creek.
- **Well-developed scientific indices:** Scientists have studied aquatic bugs for several years and have developed indices to characterize stream health based on the bug populations living in it.

For all these reasons, aquatic bugs are good indicators of water quality and mirror changes in water quality with changes in their populations. An assessment of the bug population in any stream will give an indication of the health of that stream. In addition, they are an important part of the food web and their decline indicates a potential decline of other species.

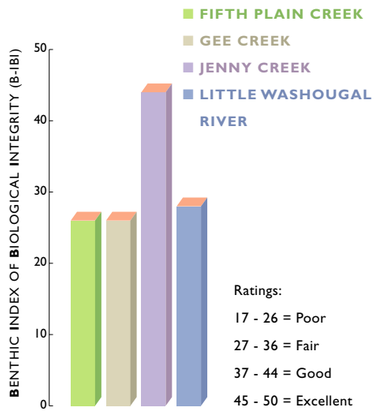
Results of macroinvertebrate sampling

One of the most common indices to determine stream health based on bug populations is the Benthic Index of Biological Integrity (B-IBI). Benthic means bottom-dwelling. Biological integrity refers to the ability of an ecosystem to support a diversity of life as compared to a similar ecosystem in a state unaltered by humans. The B-IBI takes the very complex diversity of bugs found in any given stream, and the pollution tolerances of each bug, and boils all that information down into a number score.



The scores of the volunteer sites are typical of suburban and developing rural areas. Scores are based on ten population characteristics, such as community diversity, pollution tolerance, and functional feeding groups. For example, specialized feeding groups are usually the first to disappear because they are adapted to only eat certain things in a certain way. This corresponds to an increase in pollution tolerant species, whose diet is more generalized. Gee and Fifth Plain creeks give particular cause for concern since they fall into the poor category. This means that biological integrity in these streams has been greatly impacted by pollution, such as high temperature and excess sediment. Changes in the stream flow such as lack of water in the summer and increased flooding in the winter due to urbanization are also important factors.

Average biological health scores from macroinvertebrate samples at volunteer monitored sites



MORE INFORMATION...

Web site: www.clark.wa.gov/water-resources (then click on "monitoring").

Questions about volunteering?
Please contact Jason Wolf
Clark County Public Works
Phone: (360) 397-6118 ext. 4282
E-mail: Jason.Wolf@clark.wa.gov

Questions about the data or methods?
Please contact Ron Wierenga
Clark County Public Works
Phone: (360) 397-6118 ext. 4264
E-mail: Ron.Wierenga@clark.wa.gov

CURRENTS

SPRING 2004

Newsletter of the Clark County volunteer monitoring program

Welcome to the first edition of Currents, a newsletter created by the Clark County Clean Water Program for the volunteers who have been monitoring the water quality of streams across the county since the fall of 2002. Their accomplishments of the past year are summarized here for all to share.

The Volunteer Monitoring Program involves citizens interested in learning about the health of Clark County's streams, lakes, and rivers, and provides useful data for the county's resource managers. This program utilizes equipment from the Clark County monitoring resource center, a source of training, monitoring equipment, and project guidance for participating volunteers. The program is funded by the Clark County Clean Water Program and a Washington Department of Ecology grant.

Clark County congratulates the volunteers on the successful completion of their first year collecting data. The data they collected on the Little Washougal River and on Gee, Jenny, Brezee, and Fifth Plain creeks will help guide water management decisions in those watersheds and provide a baseline for comparison over the coming decades.

The following is a summary of the program accomplishments:

VOLUNTEER ACCOMPLISHMENTS

- More than 16 visits to monitoring sites
- Seven macroinvertebrate surveys
- Four habitat surveys
- Sixteen water samples collected for bacteria and nutrient analysis
- Two noxious weed reports submitted to Clark County Weed Department staff
- Four water temperature data logger deployments
- One completed reach map and three in progress

CLEAN WATER PROGRAM ACCOMPLISHMENTS

- Increased volunteer program participation from eight active volunteers in January 2003 to 33 active volunteers in January 2004 and trained over 50 volunteers
- Completed and distributed the stream monitoring manual
- Added a second complete monitoring kit to the MRC
- Created a volunteer monitoring Web page on Clark County's Web site
- Led four training events and hosted two presentations for volunteers
- Established a new monitoring site on Brezee Creek

Ron and Judy taking water samples from Fifth Plain Creek.

INSIDE THIS ISSUE

CLARK COUNTY, WASHINGTON

Roger and Bill collect macroinvertebrates on Gee Creek.

What have we learned after one year's sampling at our sites?

Conditions at the volunteer sites reflect the land uses and the percentage of impervious area of their drainage areas, and are thus each differently impacted by pollution. Percentage of impervious area is a measurement of the areas (roads, roofs, parking lots, etc.) from which precipitation flows directly into storm water drains instead of percolating into soil.

In 2002-2003, biological, chemical, and physical stream condition parameters were measured quarterly. In this newsletter we'll focus on two of the chemical parameters (phosphorus and temperature) and one of the biological parameters (macroinvertebrate populations as a pollution indicator).

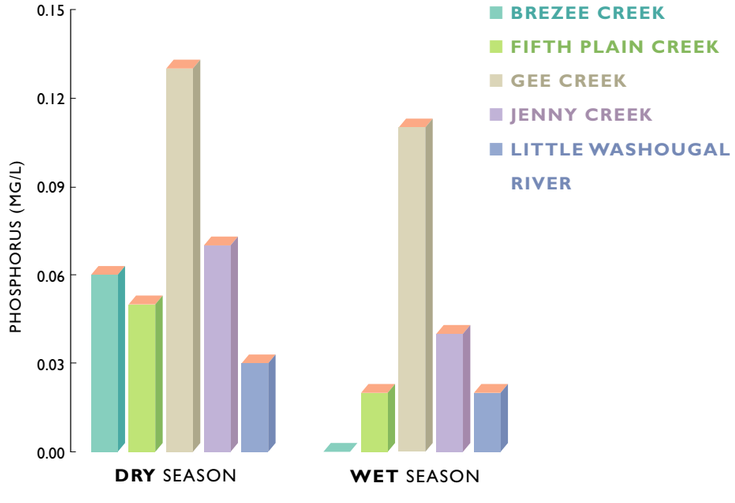
Excess nutrients in an aquatic system: *Focus on phosphorus*

Each quarter, volunteers fill bottles with creek water and send them to a lab for analysis. One of the tests determines total phosphorus in the sample, which is a nutrient essential to aquatic life. Natural sources of phosphorus include weathered rock and mineral deposits in soil. Phosphorus also comes from fertilizer from lawns and agriculture; farm, animal and pet waste; organic matter; leaking septic systems; and sediments from eroded soils.

Yet while aquatic systems would collapse without phosphorus, too much phosphorus can also cause problems, including an excess of algal and plant growth. When algae and plants die, they are broken down by bacteria and other microscopic creatures, a process that consumes oxygen. Waterways, especially slow-moving ones, can easily become oxygen-poor under such conditions.

This chart shows that total phosphorus was typically lower in winter and spring than in summer. Lower wet-season averages are likely the result of dilution by heavy rains, and don't necessarily indicate a lower net input of phosphorus. To avoid excess algal growth, the Environmental Protection Agency (EPA) recommends that total phosphorus not exceed 0.10 milligrams per liter (mg/L) for waterways not discharging directly into lakes, and not exceed 0.05 mg/L for those going directly into lakes. Only in Gee Creek was this criteria routinely exceeded. This means that Gee creek is highly susceptible to nuisance algal and plant growth, and the other creeks are somewhat susceptible. This susceptibility may bring dissolved oxygen levels below critical levels in the dry season when stream flow is at its slowest.

Average total phosphorus in dry and wet season samples at volunteer monitored sites



Lamprey, a primitive fish sensitive to water pollution, are shown clinging to rocks with their mouths. Like salmon, lamprey migrate from fresh water to salt water during their life cycle.

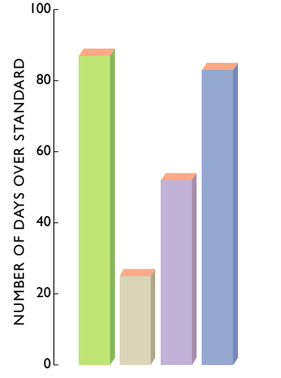
How does temperature affect aquatic life?

Temperature is one of the most commonly measured parameters that resource managers focus on when determining the condition of a particular waterway. Temperature is important to monitor because its fluctuations affect all the animals and plants in our streams, rivers, and lakes. Aquatic life forms are cold-blooded, which means water temperature controls the rate of all their biological and chemical processes such as early development, behavior, growth, and reproductive success.

Scientists have found that most aquatic organisms and fish species in the Pacific Northwest, including salmon, need water that is 64°F or lower. This is the temperature standard adopted by Washington State as necessary for the protection of life in streams. Although many species can tolerate occasional warm-water fluctuations, native fish and other aquatic organisms have evolved to live in cold water, so temperatures over 64 degrees stress their physiology.

Temperature data loggers were installed by volunteers in 2003 to take readings every hour between May and October, when water temperatures are the warmest. Results are illustrated in the graph below.

Monitoring results from all the creeks give cause for concern based on the number of days over the temperature standard. Water temperature in creeks is increased by removal of riparian vegetation from timber harvesting or other land-clearing activities, water depth, rate of water flow, and air temperature. As with many environmental problems that were created over many decades, bringing high water temperatures down will take time. Certainly, planting trees along stream corridors is a step in the right direction.



Number of days the water temperature exceeded the Washington State standard for class A streams (64°F) at volunteer monitored sites